

commonly known in the art as a process where the surface of a part is reacted to form nitride compounds in order to increase the hardness of the surface.

The plasma device may be used in a container such as an oven or furnace.

In the claims appended below mention is made of the thermo-electric environment of the device. This refers to the region where both heat and electric fields are noted on account of the device. A container containing the plasma device is for example an oven or furnace and may additionally contain other heaters (herein referred to as no-plasma heaters).

What is claimed is:

1. A plasma device for heating a gaseous flow comprising:

A first material having an inlet side for receiving a gaseous flow, an inner side for discharging said gaseous flow, and a plurality of openings, said openings providing at least one passageway from said inlet side to said inner side;

A second material having an inner side for receiving said gaseous flow, an outlet side for discharging said gaseous flow, and a plurality of openings, said openings providing at least one passageway from said inner side to said outlet side, wherein said inner side of said first material and said inner side of said second material define a gap therebetween, wherein the ratio of the sum of the volumes of the first and second materials to the volume of the gap is between about 0.2 and 5;

And

A heat source in heat transfer relation with said gaseous flow for heating said gaseous flow,

with an improvement comprising of a tungsten containing material in the thermo-electric environment of the device.

2. The device as recited in claim 1 wherein said heat source is disposed at least partially within said device for heating said gaseous flow,

with an improvement comprising of a tungsten containing material in the thermo-electric environment of the device.

3. The device is recited in claim 1 wherein said plurality of openings of said first material is a plurality of pores, and wherein said plurality of openings of said second material is a plurality of pores,

with an improvement comprising of a tungsten containing material in the thermo-electric environment of the device.

4. The device as recited in claim 3 wherein said plurality of pores of said first material are interconnected, and wherein said plurality of pores of said second material are interconnected,

with an improvement comprising of a tungsten containing material in the thermo-electric environment of the device.

5. The device as recited in claim 1 further comprising:

a fan in fluid communication with said inlet of said first material, said fan being operative for creating said gaseous flow between said first inlet side and said outlet side and

with an improvement comprising of a tungsten containing material in the thermo-electric environment of the device.

6. The device as recited in claim 5 further comprising an insulating material substantially contiguous with said inlet side of said first material,

with an improvement comprising of a tungsten containing material in the thermo-electric environment of the device.

7. The device as recited in claim 1 wherein said first material and said second material comprise a porous ceramic material,

with an improvement comprising of a tungsten containing material in the thermo-electric environment of the device.

8. The device as recited in claim 7 wherein said porous ceramic material is selected from the group consisting of borides of titanium, zirconium, niobium, tantalum, molybdenum, hafnium, chromium, and vanadium; aluminides (except of aluminum) carbides and oxides of titanium, hafnium, boron, aluminum, tantalum, silicon, tungsten, zirconium, niobium, iron, molybdenum, vanadium and chromium; carbonitrides of titanium, niobium and tantalum; nitrides of titanium, zirconium, boron, aluminum, silicon, tantalum, hafnium, and niobium; silicides of molybdenum, titanium, zirconium, niobium, tantalum, tungsten and vanadium; hybrids of titanium, zirconium and niobium; , with an improvement comprising of a tungsten containing material in the thermo-electric environment of the device.
9. The device as recited in claim 1 wherein said first material and said second material comprise a porous sodium silicate cement having a colloidal alumina coating, with an improvement comprising of a tungsten containing material in the thermo-electric environment of the device.
10. The device as recited in claim 1 wherein the ratio of the sum of the volumes of the first and second materials to the volume of the gap is between about 2.5 and about 3.5, with an improvement comprising of a tungsten containing material in the thermo-electric environment of the device.
11. The device as recited in claim 1 wherein the ratio of the sum of the volumes of the first and second materials to the volume of the gap is between about 2.9 and about 3.0, with an improvement comprising of a tungsten containing material in the thermo-electric environment of the device.
12. The device as recited in claim 1 wherein the heat source is a heating element, with an improvement comprising of a tungsten containing material in the thermo-electric environment of the device.

- 13.** The device as recited in claim 12 wherein the heating element extends from the inner side of the first material through the outlet side of the second material, with an improvement comprising of a tungsten containing material in the thermo-electric environment of the device with an improvement comprising of a tungsten containing material in the thermo-electric environment of the device.
- 14.** The device as recited in claim 1 wherein the first material is conductive and wherein the heat source comprises the first material, with an improvement comprising of a tungsten containing material in the thermo-electric environment of the device.
- 15.** The device as recited in claim 14 wherein the second material is conductive and wherein the heat source further comprises the second material, with an improvement comprising of a tungsten containing material in the thermo-electric environment of the device.
- 16.** A method of heating a gaseous flow comprising the step of :
providing a first material having an inlet side, an inner side, and a plurality of openings, said openings providing at least one passageway from said inlet side to said inner side;
providing a second material having an inner side, an outlet side, and a plurality of openings, said openings providing at least one passageway from said inner side to said outlet side, wherein said inner side of said first material and said inner side of said second material define a gap there between, wherein the ratio of the sum of the volumes of the first and second materials to the volume of the gap is between about 0.2 and 5; and
forcing gas through said first material, said gap, and said second material, with an improvement comprising of a tungsten containing material in the thermo-electric environment of the device.
- 17.** The method as recited in claim 16 further comprising the step of:
providing a heat source in heat transfer relation with said gaseous flow, with an improvement comprising of a tungsten containing material in the thermo-electric environment of the device.

18. The method of claim **16** wherein the first material and the second material are provided and configured such that the ratio of the sum of the average thicknesses of the first and second materials to the average thickness of the gap is between about 2.5 and 3.5, with an improvement comprising of a tungsten containing material in the thermo-electric environment of the device.

19. The method as recited in claim **16** wherein said gas is forced by use of a fan., with an improvement comprising of a tungsten containing material in the thermo-electric environment of the device.

20. A device for heating a gaseous flow comprising:

a first material having an inlet side for receiving a gaseous flow, an inner side for discharging said gaseous flow, and a plurality of openings, said openings providing at least one passageway from said inlet side to said inner side;

a second material having an inner side for receiving said gaseous flow, an outlet side for discharging said gaseous flow, and a plurality of openings, said openings providing at least one passageway from said inner side to said outlet side, wherein said inner side of said first material and said inner side of said second material define a gap therebetween for providing residence time for gases passing therethrough, wherein the ratio of the sum of the average thickness of the first and second materials to the average thickness of the gap is between about 1 and 5; and

a heat source in heat transfer relation with said gaseous flow for heating said gaseous flow,

with an improvement comprising of a tungsten containing material in the thermo-electric environment of the device.

21. The device as recited in claim **20** wherein the ration of the sum of the average thicknesses of the first and second materials to the average thickness of the gap is about 3, with an improvement comprising of a tungsten containing material in the thermo-electric environment of the device.

- 22.** A device for heating a gaseous flow comprising:
- a first porous ceramic material having an inlet side for receiving a gaseous flow, an inner side for discharging said gaseous flow, and a plurality of openings, said openings providing at least one passageway from said inlet side to said inner side;
- a second porous ceramic material having an inner side for receiving said gaseous flow, an outlet side for discharging said gaseous flow, and a plurality of openings, said openings providing at least one passageway from said inner side to said outlet side, wherein said inner side of said first material and said inner side of said second material define a gap therebetween for providing residence time for gases passing therethrough, wherein the ratio of the sum of the volumes of the first and second materials to the volume of the gap is between about 1 and about 5; and
- a heat source in heat transfer relation with said gaseous flow for heating said gaseous flow,
- with an improvement comprising of a tungsten containing material in the thermo-electric environment of the device.
- 23.** A device of claim 1 which may be directed at an electrically conducting surface in order to improve the rate of heat transfer to that surface.
- 24.** A container incorporating the device of Claim 23.
- 25.** A container comprising of the device of claim 1 and a non-plasma heater.
- 26.** The device of claim 1 wherein gasses are mixed with the plasma.
- 27.** The product of claim 1 which may be directed at an electrically non conducting surface in order to improve the rate of heat transfer to that surface.
- 28.** A container incorporating the device of Claim 27.

- 29.** A container incorporating the device of Claim 1.
- 30.** A device of claim one for convectively transferring plasma.
- 31.** A device of claim 1 for use for melting aluminum.
- 32.** A device of claim 1 for use as a polymeric stake welder